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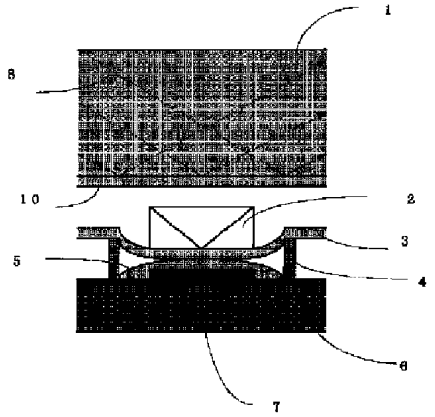
(54) OPTICAL ELEMENT

(57) Abstract:

PROBLEM TO BE SOLVED: To prevent the problem of attraction and to embody an optical switching element which may be produced at a low cost without using large- scale equipment by adding an intermediate layer composed of material hardly giving rise to the attraction between a waveguide and reflection prism which attach and detach to and from each other.

SOLUTION: This optical element comprises the waveguide 1, the intermediate layer 10 which is disposed on the boundary of the waveguide 1, the reflection prism 2 which attaches an detaches to and from the waveguide 1 via the intermediate layer 10, a conductive movable film 3 which is joined to the reflection prism 2, a substrate 6, an electrode 7, an insulating layer 5 and a spacer 4 which disposes a space between a movable film 3 and the substrate 6. The element is constitute by disposing the intermediate layer 10 composed of the material hardly giving rise to the attraction between the waveguide 1 and the reflection prism 2, by which the attraction is prevented with the simple constitution. The optical switching element which may be produced at the low cost may be embodied without requiring the large-scale production equipment and much energy.



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CLAIMS

[Claim(s)]
[Claim 1] The extract side of translucency movable in the light guide section which carried out total reflection of the introductory light, and was equipped with the total reflection side which can be transmitted, the 1st location close to below the extract distance that an evanescent wave leaks to said total reflection side, and the 2nd location left beyond said extract distance, The optical element characterized by providing one or more layers as for which a refractive index becomes both total reflection both [either or] which have the driving means to which said extract side is made to move, and face said extract side or said extract side further higher than said total reflection side and said extract side from the water-repellent quality of the material.
[Claim 2] The quality of the material of said layer is an optical element according to claim 1 characterized by being diamond[a diamond or]-like carbon.
[Claim 3] The thickness of said layer is an optical element according to claim 1 characterized by being one value of the range of 10 to 100nm.
[Claim 4] The extract side of translucency movable in the light guide section which carried out total reflection of the introductory light, and was equipped with the total reflection side which can be transmitted, the 1st location close to below the extract distance that an evanescent wave leaks to said total reflection side, and the 2nd location left beyond said extract distance, It is a part of driving means to which said extract side is made to move according to electrostatic force. The 1st electrode movable at said extract side and one, It has the 2nd electrode which is said a part of driving means similarly, and was fixed to said light guide section. The optical element characterized by providing one or more layers which said 1st electrode and said 2nd electrode are the different quality of the material, and are water repellence in both both [either or] which each of said 1st electrode or said 2nd electrode furthermore faces.
[Claim 5] The quality of the material of said layer is an optical element according to claim 4 characterized by being diamond[a diamond or]-like carbon.
[Claim 6] The quality of the material of said layer is an optical element according to claim 4 characterized by being a silicon nitride.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical element which switches light by approach and estrangement of an optical member.
[0002]

[Description of the Prior Art] The conventional technique in connection with this invention is explained.
[0003] The optical switching element which switches light on the other hand using evanescent wave coupling as shown in drawing 15 and drawing 16 is proposed. Actuation of said optical switching element is briefly explained according to drawing below.

[0004] Based on drawing 15 , it explains first. Said optical switching element consists of the conductive movable film 3 joined to the reflecting prism 2 which approaches and deserts waveguide 1 and said waveguide 1, and said reflecting prism 2, a substrate 6, an electrode 7, an insulating layer 5, and a spacer 4 that prepares space between said movable film 3 and substrates 6. Here, light is supplied to said waveguide 1 from the suitable light source. In all internal interfaces, light always carries out total reflection of said waveguide 1 repeatedly, and the include angle of the beam of light which carries out incidence from the light source, and the include angle of each side of said waveguide 1 are designed so that a beam of light may be filled. Light is confined in said waveguide 1 interior as long as there is nothing that approaches in wavelength extent of light or the distance not more than it filled with this condition by said waveguide 1.
[0005] Now, under said waveguide 1, said reflecting prism 2 exists on drawing. Said reflecting prism 2 is joined by the upper field of said movable film 3. In the condition of drawing 15 , the electrical potential difference is impressed between said electrodes 7, and said movable film 3 is being attracted through said insulating layer 5 at said electrode 7 side according to electrostatic force, and is carrying out elastic deformation. As a result, as drawing, said reflecting prism 2 had sufficient distance, and has deserted said waveguide 1. In this condition, the light of said waveguide 1 interior is confined in said waveguide 1 interior, and it does not leak and come out of it outside. This is made into a condition 1.
[0006] To a degree It explains based on drawing 16 . Drawing 16 shows the situation of said optical switching element at the time of canceling the electrical potential difference currently impressed between said movable film 3 and said electrodes 7 in said condition 1. A suction force is lost by discharge of said applied voltage, and said movable film 3 which was carrying out elastic deformation is pushing up said reflecting prism 2 with tension. Thereby, said reflecting prism 2 is pushed against said waveguide 1, or is made to approach. In that case, the so-called evanescent wave coupling arises between said waveguide 1 and said reflecting prism 2, and the light of said waveguide 1 interior oozes out to said reflecting prism 2. Furthermore, it is reflected by said reflecting prism 2, and said EBANESSENTO light which oozed out penetrates said waveguide 1, and it carries out outgoing radiation outside. In other words, the light confined in said waveguide 1 is taken out. This is made into a condition 2.
[0007] Optical switching can be performed if an above-mentioned condition 1 and an above-mentioned condition 2 are controlled by impression and discharge of said electrical potential difference. Moreover, if much aforementioned configurations are arranged in the shape of a matrix, it cannot be overemphasized that the display of an image is possible.
[0008]

[Problem(s) to be Solved by the Invention] Now, in an optical switching element as shown by drawing 15 and drawing 16 as above-mentioned, it switches by switching two conditions of approach of said waveguide 1 and said reflecting prism 2 and estrangement. Here, in almost all cases, approach is contact actually, and you may think the same way that it becomes the actuation which the thing in contact with estrangement dissociates. And in the conventional optical switching element, when said waveguide 1 and said reflecting prism 2 contacted, adsorption often arose among both, it becomes impossible to have dissociated the place which should be essentially dissociated according to membranous elastic force, and there was a problem that it may lapse into impossible of operation as a component as a result. Moreover, in the field of said reflecting prism 2 and opposite side, since contact and dissociation of said

movable film 3 and said insulating layer were performed, there was fear of adsorption similarly. The main causes of said adsorption are adhesion of the moisture in a contact part. In order to prevent said adsorption, removal of the moisture at the time of manufacture is important, and had to cope with manufacturing or giving a still more chemical water-repellent finish to the contact surface in the environment dried enough, etc. Furthermore, said component needed to be closed with a package after that, and needed to prevent mixing of future moisture.
[0009] However, in order to realize the fully dried above manufacture environments, the large-scale facility was required. Moreover, operation of such a facility requires a great quantity of energy, and is contrary to energy saving and the demand to a manufacture in recent years called environmental preservation. On the other hand, the aforementioned chemical water-repellent finish is a process which requires long time amount, and the waste fluid discharged by using the chemical of about [having become the factor of a cost rise] and many caused environmental destruction. Furthermore, the class of chemical used for a water-repellent finish may have caused environmental pollution also on the occasion of abandonment of a product.
[0010] Moreover, and the approach of solving the problem of adsorption more simply also in these is searched for. [the component using the minute drive structure of having the part which deserts / which deserts and repeat-contacts / besides the above-mentioned optical switching element]
[0011] Furthermore, as a completely different technical problem, since the evanescent wave which oozes out from said waveguide 1 in the optical switching element adapting the above evanescent wave coupling decreased quickly exponentially, there was [a problem of having to make said waveguide 1 and said reflecting prism 2 approach enough for taking out light]. Drawing 17 plots the amount P of the light taken out to the face to face dimension x of said waveguide 1 and said reflecting prism 2. If a face to face dimension increases as shown in drawing, the quantity of light will be decreased steeply. Therefore, in order to be stabilized and to take out sufficient quantity of light, it is necessary to vary and to lose a face to face dimension, when it has two or more reflecting prisms sufficiently small. However, while the error at the time of manufacture, dispersion at the time of putting two or more surface roughness of a field and said reflecting prisms 2 in order, aging, etc. exist in fact, quantity of light change is steep to a face to face dimension. Therefore, realizing enough and uniform approach had caused poor switching difficultly and as a result.
[0012] Then, this invention, The margin of the approach distance of said waveguide 1 and said reflecting prism 2 is extended, and it aims at offering the optical switching element which has the configuration which ensured switching at the same time it prevents the problem of the above-mentioned adsorption.

[0013]
[Means for Solving the Problem] (1) The light guide section which the optical element of this invention carried out total reflection of the introductory light, and was equipped with the total reflection side which can be transmitted, The extract side of translucency movable in the 1st location close to below the extract distance that an evanescent wave leaks to said total reflection side, and the 2nd location left beyond said extract distance, It has the driving means to which said extract side is made to move, and is characterized by providing one or more layers as for which a refractive index becomes both total reflection both [either or] which face said extract side or said extract side further higher than said total reflection side and said extract side from the water-repellent quality of the material.

[0014] (2) The optical element of this invention is characterized by the quality of the material of said layer being diamond[a diamond or]-like carbon in the 1st term.
[0015] (3) The optical element of this invention is characterized by the thickness of said layer being one value of the range of 10 to 100nm in the 1st term.
[0016] (4) The light guide section which the optical element of this invention carried out total reflection of the introductory light, and was equipped with the total reflection side which can be transmitted, The extract side of translucency movable in the 1st location close to below the extract distance that an evanescent wave leaks to said total reflection side, and the 2nd location left beyond said extract distance, It is a part of driving means to which said extract side is made to move according to electrostatic force. The 1st electrode movable at said extract side and one, It has the 2nd electrode which is said a part of driving means similarly, and was fixed to said light guide section. It is characterized by providing one or more layers which said 1st electrode and said 2nd electrode are the different quality of the material, and are water repellence in both both [either or] which each of said 1st electrode or said 2nd electrode furthermore faces.
[0017] (5) The optical element of this invention is characterized by the quality of the material of said layer being diamond[a diamond or]-like carbon in the 4th term.
[0018] (6) The optical element of this invention is characterized by the quality of the material of said layer being a silicon nitride in the 4th term.
[0019]

[Embodiment of the Invention] (Example 1) The example of this invention is shown below and it explains to it using drawing.
[0020] Drawing 1 and drawing 2 are the explanatory views showing the configuration of the optical switching element which is one example of this invention.
[0021] Based on drawing 1 , it explains first. Said optical switching element consists of the conductive movable film 3 joined to the reflecting prism 2 which minds the interlayer 10 prepared in the interface of waveguide 1 and said waveguide 1, and said interlayer 10, and approaches and deserts said waveguide 1, and said reflecting prism 2, a substrate 6, an electrode 7, an insulating layer 5, and a spacer 4 that prepares space between said movable film 3 and substrates 6.
[0022] Here, light is supplied from the suitable light source for said waveguide 1, and total reflection and the include angle of a beam of light which carries out incidence from the light source so that it may reflect repeatedly and a beam of light may be filled, and the include angle of each field of said waveguide 1 are always designed for light in all interfaces inside. And in this condition, as long as there is nothing that approaches in a distance shorter than the wavelength of the light filled by said waveguide 1, light is confined in said waveguide 1 interior.
[0023] Now, under said waveguide 1, said reflecting prism 2 exists on drawing. Said reflecting prism 2 is joined by the upper field of said movable film 3. First, in the condition of drawing 1 , the electrical potential difference is impressed between said electrodes 7, and said movable film 3 is being attracted through said insulating layer 5 at said electrode 7 side according to electrostatic force, and is carrying out elastic deformation. Since it is joined by said movable film 3 upper part, said reflecting prism 2 has deserted said waveguide 1 with sufficient distance as drawing. In this condition, the light of said waveguide 1 interior is confined in said waveguide 1 interior, and it does not leak and come out of it outside. This is made into a condition 1.
[0024] To a degree It explains based on drawing 2 . Drawing 2 shows the situation of said optical

switching element at the time of canceling the electrical potential difference currently impressed between said movable film 3 and said electrodes 7 in said condition 1. A suction force is lost by discharge of said applied voltage, and said movable film 3 which was carrying out elastic deformation is pushing up said reflecting prism 2 with tension. Thereby, said reflecting prism 2 is pushed against said waveguide 1, or is made to approach through said interlayer 10, and the so-called evanescent wave coupling produces it between said waveguide 1 and said reflecting prism 2. That is, the light of said waveguide 1 interior will ooze out to said reflecting prism 2. Furthermore, it is reflected by said reflecting prism 2, and said EBANESSENTO light which oozed out penetrates said waveguide 1, and it carries out outgoing radiation outside. In other words, the light confined in said waveguide 1 is taken out. This is made into a condition 2. [0025] Optical switching can be performed if an above-mentioned condition 1 and an above-mentioned condition 2 are controlled by impression and discharge of said electrical potential difference. Moreover, if much aforementioned configurations are arranged in the shape of a matrix, it cannot be overemphasized that the display of an image is possible. [0026] In addition, in this example, although said movable film 3 and said reflecting prism 2 are elastically supported by the elasticity of said movable film 3 self, needless to say, they may be separately made the configuration using supporter material or a support device. Moreover, approaches various in addition to the approach by the electrostatic force which showed said waveguide 1 and said reflecting prism 2 to drawing 1 and drawing 2 also about the device in which you make it approach and desert can be considered. For example, the approach by the piezoelectric device like a piezo actuator and an electromagnetic approach may be used. [0027] Now, it is at the conventional optical switching element, There was a problem which causes the malfunction by adsorption of said waveguide 1 and said reflecting prism 2 as already stated. Furthermore, in the field of said reflecting prism 2 and opposite side, there was fear of adsorption similarly. The main causes of said adsorption are adhesion of the moisture in a contact part. Therefore, at the time of manufacture, removal of moisture is important, and it had to cope with manufacturing or giving a still more chemical water-repellent finish to the contact surface in the environment dried enough, etc. Furthermore, said component needed to be closed with a package after that, and needed to prevent mixing of future moisture. However, in order to realize the fully dried above manufacture environments, the large-scale facility was required. Moreover, operation of such a facility requires a great quantity of energy, and is contrary to energy saving and the demand to a manufacture in recent years called environmental preservation. On the other hand, the aforementioned chemical water-repellent finish is a process which requires long time amount, and the waste fluid discharged by using the chemical of about [having become the factor of a cost rise] and many caused environmental destruction. Furthermore, the class of chemical used for a water-repellent finish may have caused environmental pollution also on the occasion of abandonment of a product. [0028] However, at this example, adsorption is prevented with the easy configuration by considering as the configuration which allotted said interlayer 10 constituted from the pile quality of the material by the lifting in adsorption between said waveguides 1 and said reflecting prisms 2. Therefore, energy of a large-scale manufacturing facility or many is not needed, but a low cost optical switching element is realized. Moreover, as said interlayer 10, if the diamond film or DLC (Diamond Like Carbon) is used, since these are the quality of the materials which cannot be charged easily, not only the adsorption by moisture but the adsorption by static electricity is prevented, and they can be made into the optical switching element which was repeatedly excellent also in endurance further here. Here, if it is the diamond film, since

permeability is high, quantity of light loss can be made small. On the other hand, if it is DLC, membranes can be formed easily and it can mass-produce at low cost. Moreover, since said diamond film and said DLC are carbon, they are harmless also to a living body, and they do not cause environmental destruction by abandonment of waste fluid or a product.
[0029] Furthermore, when said interlayer's 10 refractive index is higher than said waveguide 1 or said reflecting prism 2, another useful effectiveness can be acquired. This point is explained below.
[0030] In the conventional optical switching element adapting the above evanescent wave coupling, since the strength of the evanescent wave which oozes out from said waveguide 1 decreased quickly exponentially to distance, there was [a problem of having to make said waveguide 1 and said reflecting prism 2 approach enough for taking out light]. However, since dispersion in distance etc. existed when two or more errors at the time of manufacture, surface roughness of a field, and said reflecting prisms 2 are put in order in fact, it was difficult to realize always enough and uniform approach. Consequently, there was a possibility of sufficient quantity of light not having been obtained or producing big dispersion in the quantity of light.
[0031] However, if it is made the configuration which has said interlayer 10 like this example, and glass is used for said waveguide 1 or said reflecting prism 2 and what has a refractive index higher than a diamond or glass like DLC is used for said interlayer 10 as the quality of the material as shown below, the above-mentioned problem is improvable. This situation is shown in drawing 3 . When said interlayer 10 of 11 curve which is a continuous line cannot be found, change of the quantity of light P to the distance x of said waveguide 1 and said reflecting prism 2 in case said interlayer 10 has the curve 12 which is a dotted line taken out from said waveguide 1 is shown. First, when said interlayer 10 cannot be found, the quantity of light taken out is max when distance is 0, and, moreover, shows a sharp peak. And monotone reduction is quickly carried out as distance increases after that. On the other hand, when there is said interlayer 10, it has a loose peak in a certain distance, and becomes the curve which decreases gently-sloping. especially -- it should observe -- it is the point that the quantity of light taken out from a certain distance x1 rather than the case where said interlayer 10 cannot be found, in the range of x2 is large. That is, this shows that it is made stopping the degree of loss of power small, and to increase even if the case where said waveguide 1 and said reflecting prism 2 are not approached enough arises, and it gets by the roughness of an error or a field, dispersion, etc. in said optical switching element. Moreover, since the curve of a peak part becomes loose as aforementioned, it is said waveguide 1 and said reflecting prism 2. Fluctuation of the quantity of light taken out also to dispersion in distance decreases. In other words, the margin to dispersion in distance can be extended. This has effectiveness in stopping the nonuniformity of the brightness between pixels, when many optical switching elements of this example are arranged the shape of an array, and in the shape of a matrix and an image display device etc. is constituted.
[0032] Moreover, by making said interlayer's 10 thickness into a suitable value, the quantity of light in the target distance which can be taken out can be made into max, or dispersion over distance can be made into min here. This situation is shown in drawing 4 . When there is no curve 11 of said ten interlayer on drawing, the curve 14 of a curve 13 is the case where said interlayer's 10 optical thickness is 1/3 of wavelength for a curve 15 when said interlayer's 10 optical thickness is [said interlayer's 10 optical thickness] 1/8 of wavelength 1 / 30 case of wavelength. With optical thickness, physical thickness, i.e., an absolute size and a refractive index, is applied here. The curve of the quantity of light taken out changes with said interlayer's addition to the curve which decreases gently-sloping with a loose peak from what shows a sharp

high peak in a certain distance, when distance is 0. Moreover, if said interlayer's thickness is changed so that drawing 4 may see, the configuration of said curve will also change. That is, with said curve 13 whose optical thickness of said interlayer 10 is 1 / 30 case of wavelength, migration and slowdown of a peak are seen to the curve 11 which is the case where said interlayer 10 cannot be found, and also the value of a peak falls. With said curve 14 which is the case where said interlayer's 10 optical thickness is 1/8 of wavelength, migration of a peak and the fall of slowdown and peak value are further seen to a curve 13. With said curve 15 which is the case where said interlayer's 10 optical thickness is 1/3 of wavelength, the curvilinear configuration near a peak will become extremely gently-sloping, and the quantity of light will decrease to the whole. If the above curve is compared, in x0, a curve 11 serves as the maximum quantity of light from distance 0, and it is the most advantageous. Similarly, in distance x1 to x2, a curve 14 has the curve 13 most advantageous at x1 from distance x0. Then, by the distance of said waveguide 1 expected when actually manufacturing or manufacturing an optical switching element, and said reflecting prism and its error, the roughness of an interface, dispersion, etc., if said suitable interlayer's thickness is chosen, light can be taken out most efficiently. If drawing 4 is followed and the distance of said waveguide 1 generally expected and said reflecting prism and its error, the roughness of an interface, and dispersion will be taken into consideration, it is appropriate that said interlayer's 10 optical thickness considers as either between 1/30 and 1/3 of wavelength. When the quality of the material before and behind said diamond film or a refractive index 2.2 like said DLC is used, it is still more specifically appropriate for the thickness to consider as one value of the range of 10 to 100nm. There is no malfunction by adsorption of said waveguide 1 and said reflecting prism 2 by this, and it is possible that there is little dispersion in the quantity of light or to realize said optical switching element from which light can be taken out efficiently.

[0033] In addition, although this example showed the optical switching element of a configuration of making said reflecting prism 2 approach said waveguide 1, making said EBANESSENTO light which oozed out reflect with said reflecting prism 2, penetrating said waveguide 1, and taking out outside, idea ****** are variously made as for the structure of the optical switching element using said evanescent wave coupling to others. For example, it can consider as the optical member which makes said reflecting prism in drawing 1 reflect not but penetrate, and the optical switching element which is made to penetrate said EBANESSENTO light and takes out said movable film 3, said insulating layer 5, said electrode 7, and said substrate 6 to said transparence member, then substrate 6 side can be constituted. And if said interlayer who has suitable thickness as shown in the interface which performs said evanescent wave coupling by this example is inserted even if it is in the optical switching element of ******** or a configuration of becoming, the same effectiveness as this example, i.e., the malfunction by adsorption, cannot be found, and it cannot be overemphasized that there is little dispersion in the quantity of light or that the effectiveness that light can be taken out efficiently is acquired.

[0034] (Example 2) Drawing 5 and drawing 6 are the explanatory views showing the configuration of the optical switching element which is other one example of this invention. In the example 1, although said interlayer 10 was formed in said waveguide 1 side, as shown in drawing 5 and drawing 6 , said interlayer 10 may be formed in said reflecting prism 2 side.

[0035] Said optical switching element of this example possesses an interlayer 10 in the field which faces the waveguide 1 with which the beam of light which carried out incidence from the suitable light source is filled, and said waveguide 1, and consists of the conductive movable film

3 joined to the reflecting prism 2 which minds said interlayer 10, and approaches and deserts said waveguide 1, and said reflecting prism 2, a substrate 6, an electrode 7, an insulating layer 5, and a spacer 4 that prepares space between said movable film 3 and substrates 6. This example can acquire the same effectiveness as an example 1, and can form said interlayer 10 more easily depending on the production process of said optical switching element. Since it is the same as that of an example 1 about other configurations and effectiveness, detailed explanation is omitted.
[0036] (Example 3) Drawing 7 and drawing 8 are the explanatory views showing the configuration of the optical switching element which is other one example of this invention. In the example 1, although the diamond film or DLC was used as the middle class 10, a silicon nitride may be used instead.
[0037] Said optical switching element of this example consists of the conductive movable film 3 joined to the reflecting prism 2 which minds the waveguide 1 with which the beam of light which carried out incidence from the suitable light source is filled, the interlayer 10 who consists of a silicon nitride prepared in the interface of said waveguide 1, and said interlayer 10, and approaches and deserts said waveguide 1, and said reflecting prism 2, a substrate 6, an electrode 7, an insulating layer 5, and a spacer 4 that prepares space between said movable film 3 and substrates 6. In this example, the adsorption prevention effectiveness as well as an example 1 can be acquired, and also since said silicon nitride has also generalized a membrane formation technique and equipment, it can form an interlayer 10 easily and cheaply. Since it is the same as that of an example 1 about other configurations, detailed explanation is omitted.
[0038] (Example 4) Drawing 9 and drawing 10 are the explanatory views showing the configuration of the optical switching element which is other one example of this invention. This example changes said middle class 10 of the configuration of an example 2 into a silicon nitride from the diamond film, the diamond film, or DLC.
[0039] Said optical switching element of this example possesses an interlayer 10 in the field which faces the waveguide 1 with which the beam of light which carried out incidence from the suitable light source is filled, and said waveguide 1, and consists of the conductive movable film 3 joined to the reflecting prism 2 which minds said interlayer 10, and approaches and deserts said waveguide 1, and said reflecting prism 2, a substrate 6, an electrode 7, an insulating layer 5, and a spacer 4 that prepares space between said movable film 3 and substrates 6. In this example, an interlayer 10 can be formed easily and cheaply like an example 3. Since it is the same as that of an example 2 about other configurations, detailed explanation is omitted.
[0040] (Example 5) Drawing 11 is the explanatory view showing the configuration of the optical switching element which is other one example of this invention.
[0041] In this optical switching element shown in examples 1-4, contact and dissociation actuation are performed a field opposite to said reflecting prism 2 of said movable film 3, said electrode 7, and in between. Therefore, also in this part, there is a possibility of causing adsorption, like said reflecting prism 2 side. Then, as shown in this example, the addition layer 16 which becomes a lifting from the pile matter about adsorption may be formed in the field which faces said electrode 7 of said movable film 3, and you may make it the configuration which prevents out of control [by adsorption], and property degradation.
[0042] Said optical switching element The addition layer 16, substrate 6 which were added to the field opposite to said reflecting prism 2 of the conductive movable film 3 joined to the reflecting prism 2 which approaches and deserts the waveguide 1 with which the beam of light which carried out incidence from the suitable light source is filled, and said waveguide 1, and said reflecting prism 2, and said movable film 3 being joined, It consists of an electrode 7, an

insulating layer 5, and a spacer 4 that prepares space between said movable film 3 and substrates 6. As an example of the quality of the material of said addition layer 16, the diamond film or DLC, a silicon nitride, etc. are mentioned like the aforementioned example. According to the effectiveness of said addition layer 16, out of control [by adsorption] and property degradation are prevented also in a field opposite to said reflecting prism 2 of said movable film 3, and the optical switching element excellent in endurance and dependability is realized.
[0043] Moreover, if the diamond film, DLC, or an insulator like a silicon nitride is used as said addition layer 16, said addition layer 16 can serve as said insulating layer 5, and can be compatible in an insulating device and adsorption prevention with an easy configuration. Moreover, if this configuration is combined with the configuration of examples 1-4, said optical switching element which prevented said waveguide 1 and adsorption of said reflecting prism 2, and adsorption of said movable film 3 and said electrode 7 to coincidence is realizable.
[0044] Since it is the same as that of an example 1 about other configurations and effectiveness, detailed explanation is omitted.
[0045] (Example 6) Drawing 12 is the explanatory view showing the configuration of the optical switching element which is other one example of this invention.
[0046] Although the addition layer 16 which prevents adsorption with said electrode 7 of said movable film 3 was added to said movable film 3 side in the example 5, as shown in this example, you may make it the configuration added to said electrode 7 side.
[0047] Said optical switching element consists of an addition layer 16 added to the field which faces said movable film 3 of the conductive movable film 3 joined to the reflecting prism 2 which approaches and deserts the waveguide 1 with which the beam of light which carried out incidence from the suitable light source is filled, and said waveguide 1, and said reflecting prism 2, a substrate 6, an electrode 7, and said electrode 7, an insulating layer 5, and a spacer 4 which prepares space between said movable film 3 and substrates 6. As an example of the quality of the material of said addition layer 16, the diamond film or DLC, a silicon nitride, etc. are mentioned like the aforementioned example. According to the effectiveness of said addition layer 16, out of control [by adsorption] and property degradation are prevented also in a field opposite to said reflecting prism 2 of said movable film 3, and the optical switching element excellent in endurance and dependability is realized.
[0048] Moreover, if the diamond film, DLC, or an insulator like a silicon nitride is used as said addition layer 16 as the example 5 also described, said addition layer 16 can serve as said insulating layer, and can be compatible in an insulation and adsorption prevention with an easy configuration.
[0049] Moreover, if this configuration is combined with the configuration of examples 1-4 like an example 5, said optical switching element which prevented said waveguide 1 and adsorption of said reflecting prism 2, and adsorption of said movable film 3 and said electrode 7 to coincidence is realizable.
[0050] Since it is the same as that of an example 1 about other configurations and effectiveness, detailed explanation is omitted.
[0051] (Example 7) Drawing 13 is the explanatory view showing the configuration of the optical switching element which is other one example of this invention. Although said interlayer 10 was formed in said waveguide 1 side in the example 1 and said interlayer 10 was formed in said reflecting prism 2 side in the example 2, as drawing 13 was carried out, said interlayer 10 may be formed in both said waveguide 1 and said reflecting prism 2.
[0052] Said optical switching element of this example possesses the 2nd interlayer 18 in the

waveguide 1 with which the beam of light which carried out incidence from the suitable light source is filled, the 1st interlayer 17 prepared in the interface of said waveguide 1, and the interface which faces said waveguide 1. It consists of the conductive movable film 3 joined to the reflecting prism 2 which minds said 1st interlayer 17 and said 2nd interlayer 18, and approaches and deserts said waveguide 1, and said reflecting prism 2, a substrate 6, an electrode 7, an insulating layer 5, and a spacer 4 that prepares space between said movable film 3 and substrates 6. In this example, adsorption can be prevented still more certainly than an example 1 and an example 2 by using the quality of the material which cannot stick [silicon nitride / the diamond film or DLC,] to said 1st middle class 17 and said 2nd middle class 18 easily. Furthermore, if the case where said waveguide and said reflecting prism 2 cannot contact with surface roughness, dispersion at the time of manufacture, etc. arises, reflection may occur on the front face of said reflecting prism 2, quantity of light loss may be caused as a result, but in this example, since it is possible to carry out acid resisting by designing the thickness of said 1st interlayer 17 and the 2nd interlayer 18 the optimal, more efficient evanescent wave coupling is realizable. Furthermore, the acid-resisting effectiveness may be heightened by multilayering. Since it is the same as that of an example 1 about other configurations and effectiveness, detailed explanation is omitted.

[0053] (Example 8) Drawing 14 is the explanatory view showing the configuration of the optical switching element which is other one example of this invention.

[0054] Although the addition layer 16 which becomes a lifting from the pile matter about adsorption in the example 5 was formed in the field which faces said electrode 7 of said movable film 3 and being formed in said electrode 7 side in the example 6 on the other hand, needless to say, said addition layer may be formed in the both.

[0055] Said optical switching element The 1st addition layer 19, substrate 6 which were added to the field opposite to said reflecting prism 2 of the conductive movable film 3 joined to the reflecting prism 2 which approaches and deserts the waveguide 1 with which the beam of light which carried out incidence from the suitable light source is filled, and said waveguide 1, and said reflecting prism 2, and said movable film being joined, It consists of a 2nd addition layer 20 added to the field which faces said movable film 3 of an electrode 7 and said electrode 7, an insulating layer 5, and a spacer 4 which prepares space between said movable film 3 and substrates 6.

[0056] In this example, since it becomes a lifting with approach by pile matter, and estrangement about adsorption, adsorption is prevented still more highly and the optical switching element which was more excellent in endurance and dependability is realized. Moreover, although it may be necessary in actual membrane formation to insert a layer which is often different for convenience' sake on manufacture in addition to the target layer, said 1st addition layer 19 and the 2nd addition layer 20 may be multilayered in that case. Since it is the same as that of other examples about other configurations and effectiveness, detailed explanation is omitted.

[0057]

[Effect of the Invention] According to this invention, the effectiveness taken below is brought about.

[0058] (1) The optical element of this invention can be manufactured for the configuration which prevents adsorption by adding the waveguide which approaches and deserts, and the interlayer constituted from the pile quality of the material by the lifting in adsorption between reflecting

prisms, without using a large-scale facility. Therefore, since a low cost optical switching element is realized, excelling in endurance repeatedly and also the energy which manufacture takes compared with the conventional product is reduced, it excels also from a viewpoint of environmental preservation. Furthermore, even if the case where said waveguide and said reflecting prism do not approach enough arises by the error at the time of manufacture, dispersion of distance with said waveguide at the time of putting two or more roughness of a field, and said reflecting prisms in order, etc., the degree and dispersion of loss of power can be small suppressed by work of said interlayer. It is possible to realize said optical switching element from which dispersion in the quantity of light can take out light few most efficiently by considering as either between 1/30 and 1/3 of the wavelength of the light which is going to take out said interlayer's optical thickness especially. As a result, the yield also improves and productive efficiency is also improved sharply. Moreover, if the diamond film or DLC is used as said interlayer, not only the adsorption by moisture but the adsorption by static electricity will be prevented. Therefore, it can consider as the optical switching element which was repeatedly excellent also in endurance further. Moreover, since the diamond film and DLC are carbon, they are harmless also to a living body, and they do not cause environmental destruction by abandonment of waste fluid or a product.

[0059] (2) The optical element of this invention forms said interlayer in said waveguide side, and also may be formed in said reflecting prism side, As a result, both can acquire the same effectiveness, and if the above is chosen by the production process, said interlayer can be formed more easily.

[0060] (3) In the optical element of this invention, when a silicon nitride is used as the middle class, since said silicon nitride has also generalized a membrane formation technique and equipment, while it can acquire the adsorption prevention effectiveness more easily like the case of the diamond film or DLC, it can form said middle class more easily and cheaply.

[0061] (4) In the optical element of this invention, also in a field opposite to said reflecting prism of said movable film, when the addition layer which becomes a lifting from matter, such as pile diamond film or DLC, and a silicon nitride, about adsorption is formed in the field which faces said electrode of said movable film, the malfunction by adsorption is prevented also in said field, and the optical switching element excellent in endurance and dependability is realized. Moreover, when the diamond film or an insulator like DLC is used as said addition layer, said addition layer can serve as said insulating layer, and can be compatible in an insulating device and adsorption prevention with an easy configuration.

[0062] (5) In the optical element of this invention, if the addition layer which consists of the diamond film which prevents adsorption with said electrode of said movable film or DLC, a silicon nitride, etc. is added to said electrode side, in a field opposite to said reflecting prism of said movable film, out of control [by adsorption] and property degradation will be prevented like the preceding clause, and the optical switching element excellent in endurance and dependability will be realized. Moreover, if the diamond film or DLC, and an insulator like a silicon nitride are used as said addition layer, said addition layer can serve as said insulating layer, and can be compatible in an insulation and adsorption prevention with an easy configuration.

[0063] (6) If said interlayer is formed in both said waveguide and said reflecting prism, adsorption can be prevented still more certainly. Moreover, since it is possible to carry out acid resisting by designing the thickness of a layer the optimal, an optical switching element with the more high effectiveness of evanescent wave coupling is realizable. Furthermore, it is possible by

multilayering to heighten the acid-resisting effectiveness and to constitute an efficient optical switching element.
[0064] (7) adsorption -- a lifting -- being hard -- if the addition layer 16 which consists of matter is formed in the field which faces said electrode of said movable film and it forms also in said electrode 7 side further -- adsorption -- a lifting -- being hard -- since it becomes approach by matter, and estrangement, adsorption is prevented still more highly and the optical switching element which was more excellent in endurance and dependability is realized.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The explanatory view showing one example of the optical element of this invention.
[Drawing 2] The explanatory view showing one example of the optical element of this invention.
[Drawing 3] The explanatory view for explaining one example of the optical element of this invention.
[Drawing 4] The explanatory view for explaining one example of the optical element of this invention.
[Drawing 5] The explanatory view showing other one example of the optical element of this invention.
[Drawing 6] The explanatory view showing other one example of the optical element of this invention.
[Drawing 7] The explanatory view showing other one example of the optical element of this invention.
[Drawing 8] The explanatory view showing other one example of the optical element of this invention.
[Drawing 9] The explanatory view showing other one example of the optical element of this invention.
[Drawing 10] The explanatory view showing other one example of the optical element of this invention.
[Drawing 11] The explanatory view showing other one example of the optical element of this invention.
[Drawing 12] The explanatory view showing other one example of the optical element of this invention.
[Drawing 13] The explanatory view showing other one example of the optical element of this invention.
[Drawing 14] The explanatory view showing other one example of the optical element of this invention.
[Drawing 15] The explanatory view showing an example of the conventional optical element.
[Drawing 16] The explanatory view showing an example of the conventional optical element.
[Drawing 17] The explanatory view for explaining an example of the conventional optical element.

[Description of Notations]

1 Waveguide

2 Reflecting Prism

3 Movable Film

4 Spacer

5 Insulating Layer

6 Substrate

7 Electrode

8 Incident Light

9 Reflected Light

10 Interlayer

11 Curve in case There is No Interlayer

12 Curve in case There is an Interlayer

13 Curve in case Interlayer's Optical Thickness is 1/30 of Wavelength of Light

14 Curve in case Interlayer's Optical Thickness is 1/8 of Wavelength of Light

15 Curve in case Interlayer's Optical Thickness is 1/3 of Wavelength of Light

16 Addition Layer

17 1st Interlayer

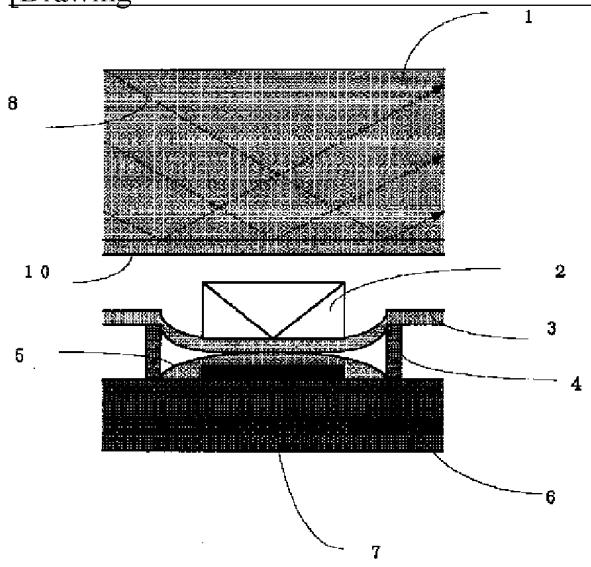
18 2nd Interlayer

19 1st Addition Layer

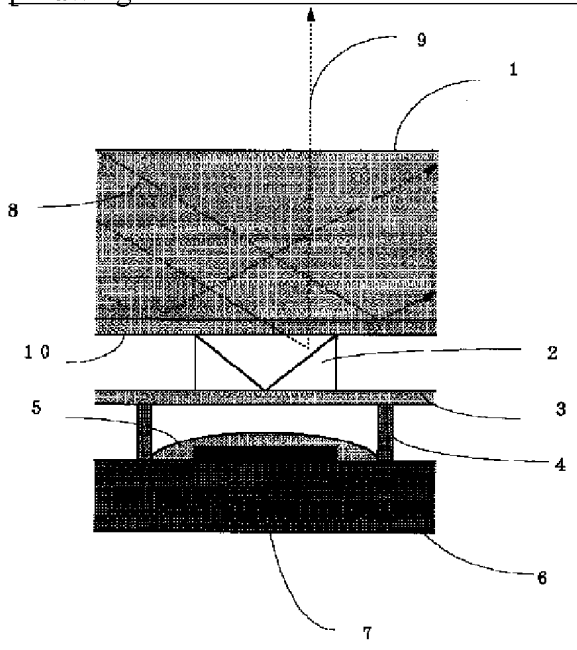
20 2nd Addition Layer

DRAWINGS

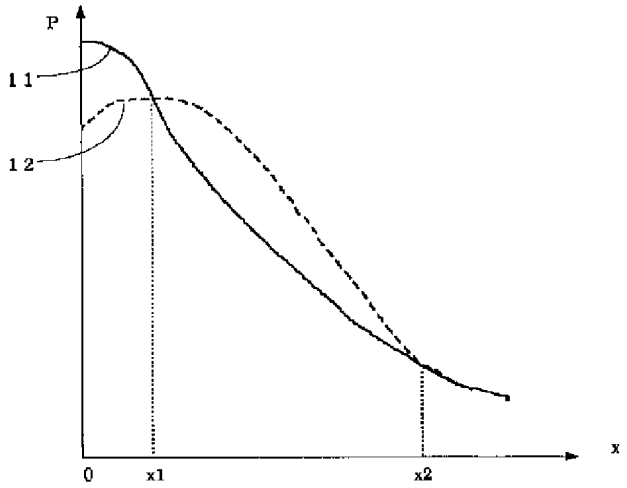
[Drawing 1]



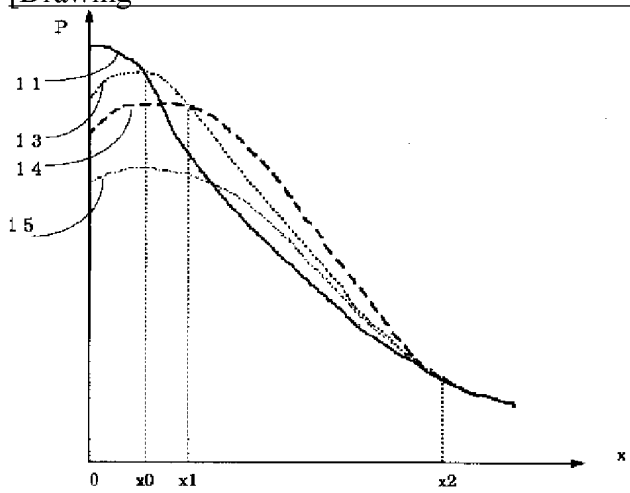
[Drawing 2]



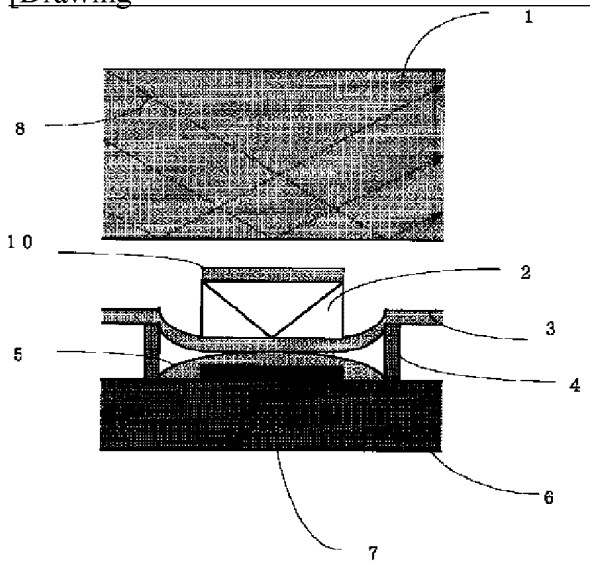
[Drawing 3]



[Drawing 4]



[Drawing 5]



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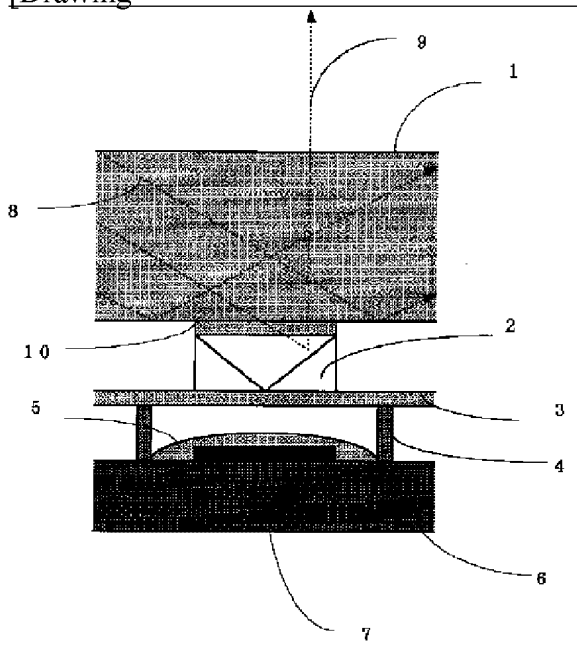
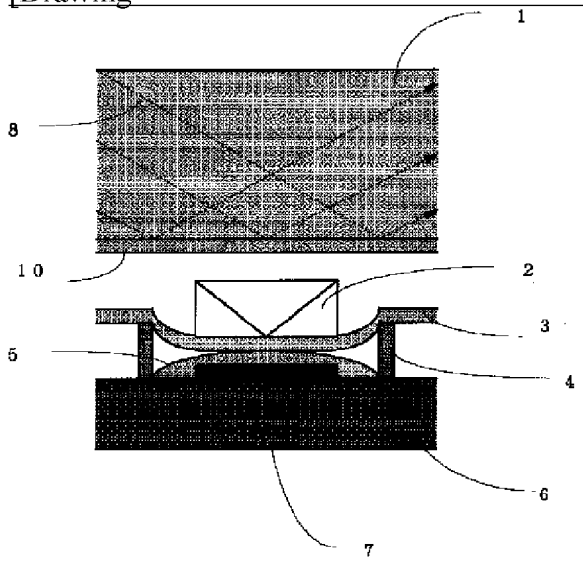
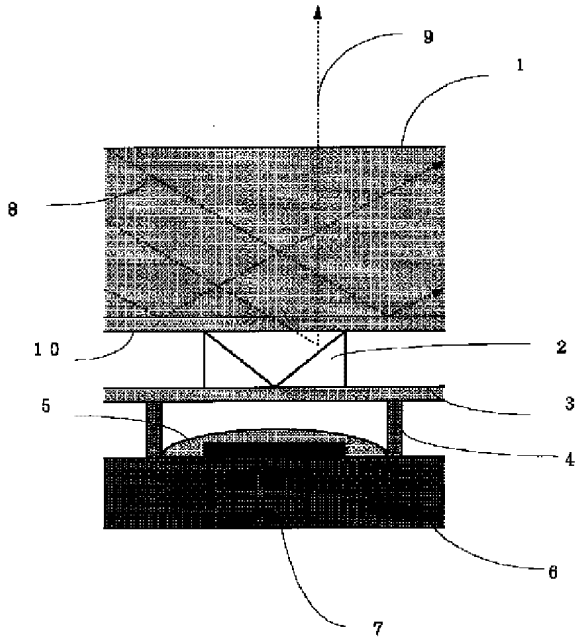


[Drawing 7]



[Drawing 8]



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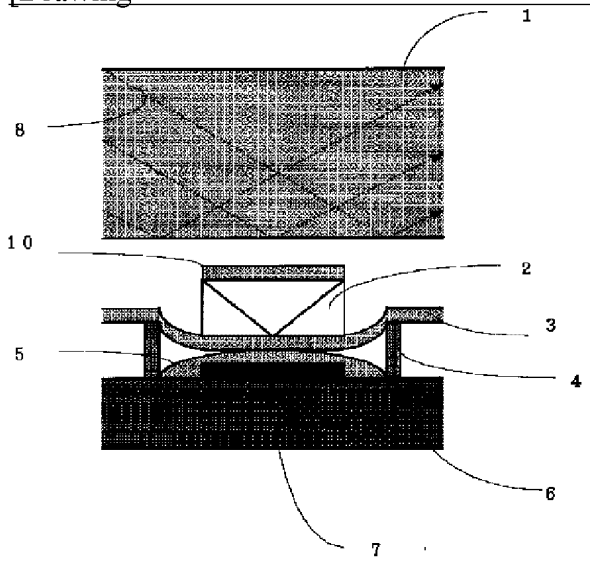
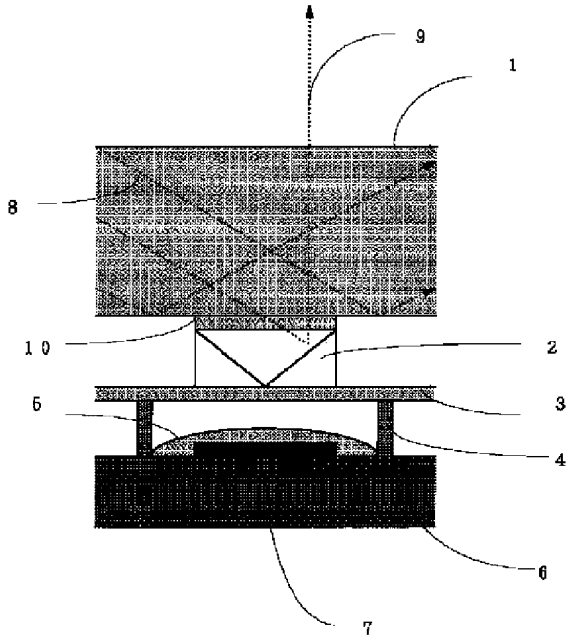
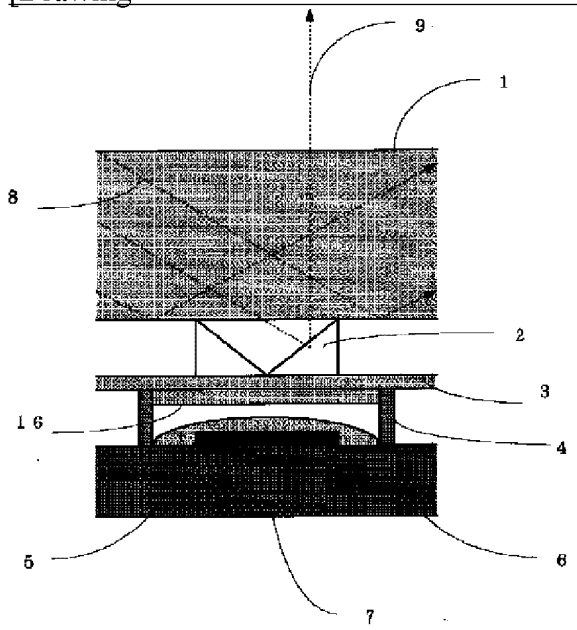


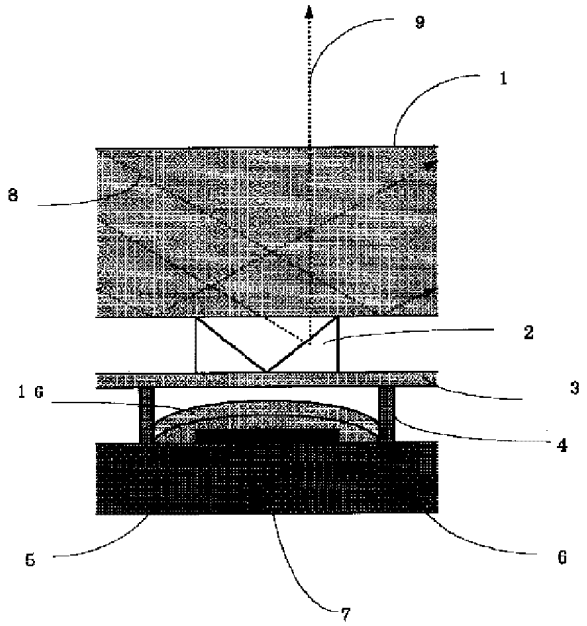
[Drawing 10]



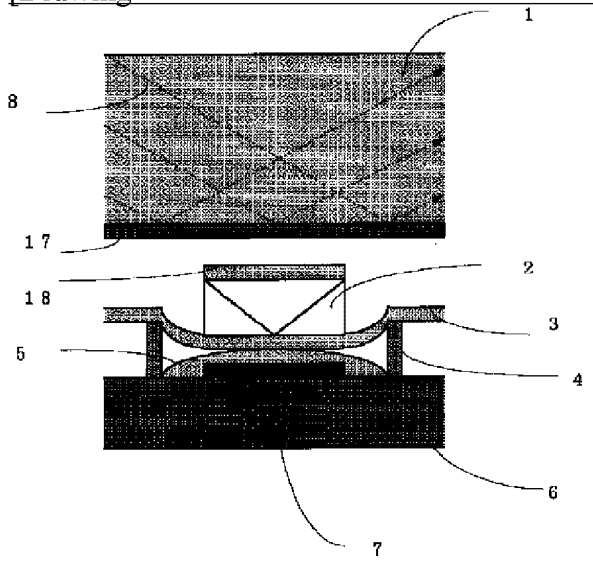
[Drawing 11]



[Drawing 12]



[Drawing 13]



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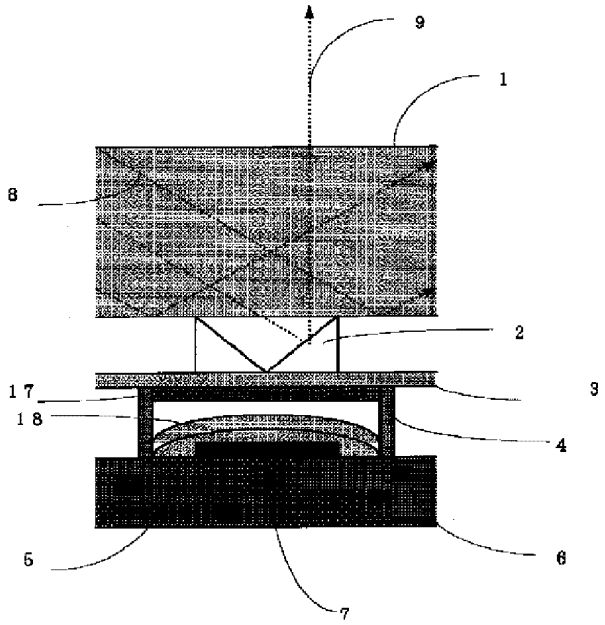
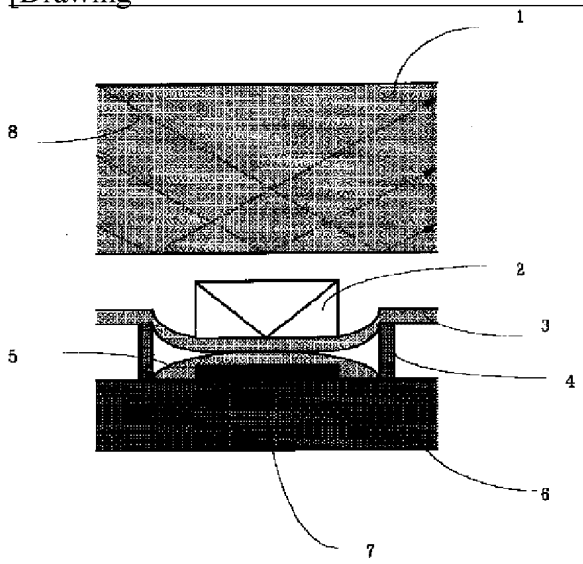
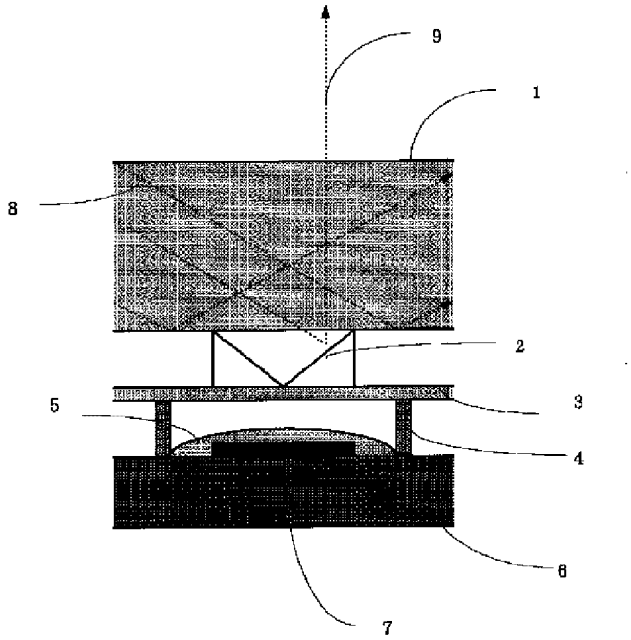


[Drawing 15]



[Drawing 16]



[Drawing 17]